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The Effect of Three Teaching Methods on Achievement and Motivational Outcomes in a How-to-Study Course

JOHN D. KRUMBOLTZ AND WILLIAM W. FARQUHAR

Michigan State University[1]

I. THE PROBLEM[1]

INSTRUCTION in study skills has been a part of the American college scene since the early 1920's. Since that time much effort has been expended developing techniques of skill and evaluating their effectiveness, but little attention has been given to the role of the teacher in teaching the skills. The present investigation is an attempt to analyze several methods of instruction as they relate to student outcomes in a how-to-study course.

Two broad classifications of outcomes are considered. The first is termed "achievement outcomes," and it is defined in terms of the specific learnings which take place during the course of instruction. The learnings involve specific knowledge about effective methods of study, knowledge of research studies and their outcomes that cast light on study skills, knowledge of human characteristics that may help or hinder studying, and specific facts about reading, writing, outlining, note-making, testing, and concentrating that should help in study problems. Knowledge of this nature is important in gaining an understanding of the purpose and techniques of effective study, but in and of itself does not guarantee practical application of the techniques learned. Therefore, it is also important to measure the extent to which students adopt the methods they learn into their own study habits, and the extent to which they form attitudes conducive to good study. Thus, knowledge and practice are two indispensable measures of student achievement in a how-to-study course.

The second classification of outcomes may be termed the "motivational outcomes"—an area which has been virtually ignored in experimental studies on the outcomes of teaching. Educators have not been unaware of the problem of motivation; the educational literature contains many references to the importance of motivating students. Many techniques and devices have been suggested in an attempt to raise the motivational level of students. However, almost no experimentation has been done to determine the actual value of the suggestions. For the purposes of this study, one particular motive is under consideration—the need to achieve. Need to achieve may be considered as an internal drive toward a specific action directed toward achieving what is called "success" in the American culture. Achieving success involves being able to gain the recognition of one's fellow man; it involves striving to compete against some standard of excellence. In short, it may be called "drive" or "ambition." The achievement motive is not confined to one field of endeavor. The actual task is unimportant; it is the individual's attitude or internal state of affairs impelling him to be successful which is important.

Purpose

The primary purpose of the present investigation is to study both the achievement outcomes and the motivational outcomes associated with different methods of teaching in a how-to-study course. We are concerned with identifying instructional methods that are most effective in improving the students' knowledge of effective study methods, in encouraging the actual application of these methods, and in increasing the students' level of achievement motivation.

Two important subsidiary problems involve the question of whether the method that is best for one type of student is also best for another. First, what influence does preference for a certain

[1] This monograph is a compilation of two Ph.D. theses completed at the University of Minnesota. The authors are indebted to their major advisors, C. Gilbert Wrenn and Willis E. Dugan, for their advice and assistance in this research.

type of instruction have on achievement and motivational outcomes? For example, do students achieve better when they receive the type of instruction they prefer, or do they perhaps learn more under an instructional method they do not like? Second, what relationship exists between student ability-level and type of instruction received? For example, do bright students achieve better under one type of instruction while the less bright students improve more under another teaching method? The various interactions between teaching method and student preference for method, and between teaching method and student ability-level are tested in this investigation. The specific null hypotheses are outlined in Part II.

Unique Aspects of the Study

Birney and McKeachie (2), in a 1955 review of the literature on teaching methods in psychology, defined two principal types of teaching methods—an instructor-centered and a student-centered method. Most of the studies cited by Birney and McKeachie consist of a comparison of the effectiveness of these two methods. Why is it necessary to use only these extreme methods? Is it not conceivable that a combination of methods might be more effective than strict adherence to any one? The present experiment makes use of an eclectic teaching method, an attempt to combine the advantages of both of the extreme methods. At the same time an instructor-centered and a student-centered method are also compared. The methods are defined in Part III.

Another important feature of this investigation is that it measures motivational outcomes in addition to achievement outcomes. To the best of the authors' knowledge, no studies have yet been performed measuring directly motivational outcomes associated with different teaching methods. The reason for this lack has probably been that adequate measures of motivation have not been available. It is only within the last few years that relatively valid measures of motivation have been developed. The measures used in the present investigation are described in Part IV.

The design of the experiment constitutes an important improvement over the design of many other studies in this area. Farquhar (6) has critically reviewed the literature on teaching methods and has pointed out many of the methodological faults underlying previous experiments. The present investigation seeks to overcome many of the design limitations of previous studies in order to secure more defensible interpretations of results. The details of the design are outlined in Part II.

II. The Design of the Experiment

The study is designed to investigate differences in achievement and motivational outcomes which may be associated with three teaching methods. As a self-contained experiment, it embodies three principles essential to modern research: randomization, replication, and control (12).

The Basic Plan

The teaching methods used in this study are instructor-centered, student-centered, and eclectic. Two instructors at two different times teach six sections of the how-to-study course using all three methods. Instructor A teaches by all three methods during the morning; instructor B teaches by all three methods during the afternoon hours. The relative contribution of the different times and the different instructors to experimental outcomes cannot be separated within the limits of this design. The combined effect will henceforth be referred to as time-instructor.

The design of the experiment is summarized in Table 1.

TABLE 1

Summary of the Basic Experimental Design

Time-Instructor	Method		
	Instructor-Centered	Eclectic	Student-Centered
Instructor A: Morning	Section 1	Section 2	Section 3
Instructor B: Afternoon	Section 4	Section 5	Section 6

Complete randomization was not possible because of administrative difficulties. Students were randomly placed among the three teaching methods, but not between time-instructors. It is necessary to isolate the differences between the effect of time-instructors in the analysis, but this effect is not central to the purpose of the study. The primary problem is to detect differences in outcomes among methods. This randomization procedure provides the basis for obtaining a valid estimate of experimental error so that a probability statement about method differences based on a known distribution can be made.

Replication is accomplished by having each method taught by two instructors rather than one. This not only permits a valid estimate of experimental error, but also tends to diminish experimental error.

Each method provides a control on each of the others. No attempt is made to provide a section which is given no instruction in how to study. No one section is designated as the control section or as the experimental section. Each section is both a control and an experimental section in relation to each of the other sections.

Primary Null Hypotheses

Four criterion measures are to be used in the main analysis and a complete description of these instruments is found in Part IV. With these measures the following null hypotheses are to be tested:

1. No differences exist among mean scores of the criterion instruments attributable to different methods of teaching.

2. No differences exist between mean scores of the criterion instruments attributable to different time-instructors.

3. No interaction effect exists between teaching method and time-instructor.

Subsidiary Null Hypotheses

From the many possible subsidiary problems growing out of a study of this nature, two seem to be especially pertinent. One involves an attempt to discover relationships between preference for certain instructional methods and different outcomes associated with the actual teaching by these methods. The other is concerned with the relationship of students' ability level to different outcomes of these methods.

The following procedure is utilized in making the first subsidiary analysis: The students taught by identical methods (though by different instructors) are pooled and then split according to their preference for certain teaching methods. Preference is measured by the Preferred Instructor Characteristics Scale (PICS) which is fully described in Part IV. The design is represented in Table 2.

The following subsidiary null hypotheses are to be tested:

1. No differences exist among mean scores of the criterion instruments attributable to different instructional methods.

2. No differences exist among mean scores of the criterion instruments attributable to preference for teaching methods.

3. No interaction effect exists between teaching method and preference for instructional method.

The main concern of this design is with the third hypothesis—the test for interaction. From this hypothesis it will be possible to determine whether students with a certain preference are more motivated by one instructional technique than another.

A similar procedure is followed in analyzing ability-level relationships. The students taught by identical methods are

TABLE 2

SUMMARY OF DESIGN FOR SUBSIDIARY ANALYSIS OF PREFERENCE FOR INSTRUCTIONAL METHOD

Preference for:	Actual Method of Instruction		
	Instructor-Centered	Eclectic	Student-Centered
Instructor-Centered	(Scores on each of the criterion tests are entered in the nine cells of this table.)		
Electic			
Student-Centered			

TABLE 3

SUMMARY OF DESIGN FOR SUBSIDIARY ANALYSIS ON ABILITY LEVEL

Ability Level	Actual Method of Instruction		
	Instructor-Centered	Eclectic	Student-Centered
High Third	(Scores on each of the criterion tests are entered in the nine cells of this table.)		
Medium Third			
Low Third			

again pooled and this time split into thirds on the basis of their scholastic aptitude level as measured by the American Council on Education Psychological Examination (ACE). The design is summarized in Table 3.

The following null hypotheses are to be tested:

1. No differences exist among mean scores of the criterion instruments attributable to different teaching methods.
2. No differences exist among mean scores of the criterion instruments attributable to different ability levels.
3. No interaction effect exists between teaching method and ability level.

Here, as in the first subsidiary analysis, the primary concern is with the interaction hypothesis—the indication of whether students of certain ability-levels are more affected by one instructional technique than another.

The procedure of pooling students taught by identical methods but different time-instructors is justifiable in the subsidiary analysis if there are no significant time-instructor differences and no significant interaction between time-instructor and method in the primary analysis. If the preceding conditions are not met in the primary analysis, the data can be analyzed by a three-way analysis of variance and covariance, isolating the effects of time-instructor, method, and ability level or preference for method variables.

Statistical Analysis

Analysis of variance and analysis of covariance are the fundamental statistical tools used in the present investigation. It is possible by the use of these tools to isolate the sum of the squares associated with each experimental variable and test its significance statistically.

Certain assumptions are involved in the use of these tools.

1. The observations should be normally distributed within each cell. This assumption of normality is seldom tested. As Johnson states, "This assumption, however, is not especially important" (12). It is not tested in the present investigation.
2. Variance within cells should be equal. This is an important assumption and is tested by the L_1 Test (see reference 12).
3. Observations should be randomly selected. Details of the present randomization procedure are found in Part III.
4. In covariance problems the linear regression coefficients of posttest scores on pretest scores should be equal within cells. The test of this assumption is provided by a test of the homogeneity of regression coefficients (see reference 10).

Each of the four criterion tests is administered before and after the instructional period. The results of the *first administration* are hereafter referred to as *pretest* scores and the results of the *second administration* as *posttest* scores. By this technique, it is possible to adjust statistically differences in posttest scores for initial differences in pretest scores through analysis of covariance.

The number of students falling in each cell is not equal. Therefore, a special computational technique is required in a two-way analysis of variance, if an exact test of significance is desired. Such an exact test, involving a least-square analysis solved by pivotal condensation (4), is employed in the present investigation.

The level of significance for rejecting the primary and subsidiary null hypotheses is arbitrarily set at the five per cent level. For tests of assumptions the one per cent level is set.

III. EXPERIMENTAL PROCEDURES

This part is concerned with outlining in detail the experimental procedures specified in the design. The selection of

a random sample, the specific definitions of the instructional situation and methods, and the various checks on the qualitative differences among methods and the consistency of instruction between instructors are developed in this order.

Selection of the Sample

One assumption underlying the use of the statistical tools of this investigation is randomness of observations. Before the experiment actually started, it was therefore necessary to specify the population accurately, and to devise a procedure to assign this population randomly to the three teaching methods under investigation.

The Population

The population for this study consists of all University of Minnesota students who elected to take Personal Orientation 1, How to Study, in the winter quarter of 1955. This population consists of both male and female students from five colleges of the University: the College of Science, Literature, and the Arts, the Institute of Agriculture, the Institute of Technology, the College of Education, and the General College. Most of these students are freshmen and sophomores, but a few are upperclassmen.

In no way can this population be considered a random sample of the entire college and university population of the United States, nor can it be considered even representative of the University of Minnesota. Students enroll in a how-to-study course for a variety of reasons. Most feel that they need help with their study problems and are motivated to the point where they want to take action. No conclusions about this population can justifiably be generalized to other dissimilar populations.

Randomization Procedure

Students desiring to register for Personal Orientation 1, How to Study, given in the winter quarter of 1955, were required to have the written consent of the instructor. Obtaining permission of the instructor is not the usual procedure with this course, but it was considered necessary as an aid in the randomization procedure.

The purpose of the randomization procedure was to place students at random in one of the three teaching methods. No attempt was made to place students randomly between time-instructors. The procedure was designed so that students could have their choice of a morning or afternoon class and the corresponding instructor. But once that decision was reached, the one section out of the three possible sections of that time-instructor was determined randomly.

When a student appeared for registration, he was given a choice of two sections which had been predetermined in a random manner except that one was always from the morning sections and the other from the afternoon sections. If he were able to accept one of these two sections, he was entered as a random student for that section. The next student to appear for registration was given his choice of the next pair of randomly determined section numbers.

If, for any one of a number of acceptable reasons, a student was unable to work the randomly assigned section into his schedule, he was allowed to sign up for the section he desired, but was designated a nonrandom student in that section. The next student to appear was then given the choice of the same two section numbers which had been unacceptable to the previous student.

The procedure continued until one of the sections was filled to capacity (30 students). Thereafter, no more random assignments were made in the remaining two sections for that time-instructor. The succeeding registrants in those two sections were all designated as nonrandom. Random assignment continued in the other time-instructor sections until one of these sections was filled. All of the remaining registrants were then designated as nonrandom. At the end of the procedure 192 students had registered. Of these, 121, or 63 per cent, were randomly assigned. The remaining 71 students, or 37 per cent, were nonrandomly assigned.

Characteristics of the Population

During the winter quarter in which instruc-

TABLE 4

NUMBER OF STUDENTS FALLING IN EACH COLLEGE CLASS AND SECTION

Class	Random or Nonrandom	Section						Total
		Time-Instructor A			Time-Instructor B			
		1	2	3	4	5	6	
Freshmen	Random	13	16	17	13	17	8	84
	Nonrandom	6	6	9	8	4	8	41
Sophomores	Random	6	3	3	2	3	6	23
	Nonrandom	1	2	2	2	3	7	17
Juniors	Random	1	0	1	2	0	1	5
	Nonrandom	0	0	0	2	2	0	4
Seniors	Random	0	0	0	0	0	0	0
	Nonrandom	2	0	0	1	0	0	3
Total	Random	20	19	21	17	20	15	112
	Nonrandom	9	8	11	13	9	15	65

tion took place, fifteen students dropped from the course. No particular disproportion appears among the sections, between time-instructors, or between the random and nonrandom groups. It seems safe to conclude that the distribution of dropouts introduces little bias into the results.

The remaining students consist of 112 random and 65 nonrandom students. The distribution of these students by college class and by section appears in Table 4. About 75 per cent of the randomly placed students are freshmen, 21 per cent are sophomores, 4 per cent are juniors, and zero per cent are seniors. In general, the placement of the nonrandom students was similar to that of the random.

The proportion of random students to the total enrollment in each of the six sections tends to be approximately the same. The range is from 50 per cent in section 6 to 70 per cent in section 2. The proportion of random students in the entire group is 63 per cent.

Distribution of students by sex is presented in Table 5. It is evident that the proportion of each sex within sections and between random and nonrandom groups remains reasonably constant. However, as an additional check on this factor, separate analyses are reported in Part V for the males only and for the males and females combined.

The distribution of students by college is summarized in Table 6. About 75 per cent of the randomly assigned students are registered in the College of Science, Literature, and the Arts, 12 per cent in the College of Education, 3 per cent in the Institute of Technology, 4 per cent in the Institute of Agriculture, and 6 per cent in the General College. The proportion of nonrandom students from each of these colleges is similar, considering the small frequencies involved.

TABLE 5

NUMBER OF STUDENTS OF EACH SEX IN EACH SECTION

Sex	Random or Nonrandom	Section						Total
		Time-Instructor A			Time-Instructor B			
		1	2	3	4	5	6	
Male	Random	17	16	19	10	12	9	83
	Nonrandom	7	7	9	11	7	12	53
Female	Random	3	3	2	7	8	6	29
	Nonrandom	2	1	2	2	2	3	12
Total	Male	24	23	28	21	19	21	136
	Female	5	4	4	9	10	9	41

TABLE 6

NUMBER OF STUDENTS FROM EACH COLLEGE OF THE UNIVERSITY, BY SECTION

College	R = Random NR = Nonrandom	Section						Total
		Time-Instructor A			Time-Instructor B			
		1	2	3	4	5	6	
Science, Literature, and Arts	R	14	14	19	11	14	12	84
	NR	6	7	10	11	8	13	55
Education	R	1	3	0	5	3	1	13
	NR	2	0	0	1	1	1	5
Institute of Technology	R	1	0	1	0	0	1	3
	NR	0	0	0	0	1	0	1
Institute of Agriculture	R	2	0	1	1	1	0	5
	NR	0	0	0	0	0	1	1
General College	R	2	2	0	0	2	1	7
	NR	1	1	1	0	0	0	3
Total	R	20	19	21	17	20	15	112
	NR	9	8	11	13	9	15	65

An accurate attendance record was kept throughout the quarter. It was important to check this factor in order to ascertain whether the students from different sections had an equal exposure to the instructional method. Out of a total of 29 class periods during the quarter, the random students missed an average of 2.07 class periods, or 7.1 per cent, while the nonrandom students missed an average of 2.72 class periods, or 9.4 per cent. The average number of class periods missed for the random students of each section remained relatively constant over all six sections. The range was from 1.65 class periods (5.7 per cent) in sections 4 and 5 to 2.79 class periods missed (9.6 per cent) in section 2. The absences were few enough in any section and relatively constant enough among sections to justify the conclusion that this factor introduces little bias into the results.

Do the sections vary in terms of their average scholastic aptitude? Records of the American Council on Education Psychological Examination (ACE) were obtained from the Student Counseling Bureau. Scores on different forms of this examination were converted to equivalent raw scores on the 1952 form by means of conversion tables provided by the Student Counseling Bureau. A summary of the mean raw scores of random students for each section appears in Table 7.

TABLE 7

MEAN RAW SCORE ON THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION FOR EACH SECTION RANDOMLY PLACED STUDENTS ONLY

Sex	Time Instructor	Method			Total
		Instructor Centered	Eclectic	Student-Centered	
Males and Females Combined	A	98.75	107.95	103.86	104.05
	B	96.69	98.05[a]	94.87	96.69[a]
	Total	97.83	102.87[a]	100.11	100.27[a]
Males Only	A	99.76	111.06	103.32	104.54
	B	94.89	99.50[a]	89.89	95.23[a]
	Total	98.08	106.11[a]	99.00	101.13[a]

[a] The number of students in these cells is one less than would be expected because no ACE score was available for one randomly placed male in Section 5.

An examination of Table 7 reveals a tendency for the sections of time-instructor A to score higher than the sections of time-instructor B, while scores in sections taught by the same method seem to be relatively more homogeneous. An exact test of significance using analysis of variance was made to investigate the statistical significance of these differences.

For the males and females combined, differences in mean scores between time-instructors and among methods do not reach significance. However, when males only are analyzed, the difference between time-instructors becomes significant at the five per cent level, but differences among methods remain insignificant. The interactions are not significant in either case.

This significant difference between time-instructors could possibly be a result of the manner of randomization. Students were given a choice of a certain time-instructor but were randomly assigned to methods. Possibly some selective factor operated in making this choice to create the significant difference. The important fact, however, is that no significant differences exist among methods. Apparently the randomization procedure was successful in distributing students among the three methods so that approximately equal means and variances resulted.

To compare the average ACE standing of the random and nonrandom students, Student's t test, as reported by Johnson (12, p. 72), is used. The 61 nonrandom students on whom ACE scores are available have a mean raw score of 103.23; the 111 random students have a mean of 100.34. The variances are approximately equal ($F = 1.35$). The resulting t value is .917 and is nonsignificant. It may be concluded that the two groups are approximately equal in scholastic ability.

The Nonrandom Students

The 65 students who could not be randomly assigned are not included in the analysis of results. The data presented in the preceding section show that they are not essentially different from the randomly placed students on any of the characteristics examined. However, it is impossible to examine the differences between the two groups on every variable that might have any relevance, and no attempt in that direction has been made.

In order to meet the assumptions of the statistical tools, it was judged best to confine the analysis only to the randomly placed students. The possible influence of the nonrandom students on the random students in each section has been considered, but the subjective impression of the instructors is that they exerted no influence out of proportion to their number. The students themselves did not know whether they had been randomly or nonrandomly assigned, and this concept was never discussed with them.

The Instructional Situation

For a more complete understanding of the experiment, it is important to consider the setting, the particular course involved, and the instructors themselves. This section is devoted to a brief description of these factors.

The Setting

All classes met in Room 307, Johnston Hall, on the University of Minnesota Minneapolis campus. The room was equipped with movable tables and chairs, which were ordinarily placed in one large circle. The room was also equipped with black shades so that it could be darkened for use of visual aids. A blackboard ran the length of one wall.

The Course

Personal Orientation 1, How to Study, is a two-credit, one quarter course. Classes meet on Mondays, Wednesdays, and Fridays during a ten-week quarter. Administratively it is placed in the General Studies Department of the College of Science, Literature, and the Arts. It is open to students from other colleges, and there are no prerequisites.

The college bulletin describes the course in the following terms:

"Practical assistance to the student in developing efficient methods of study and concentration, organizing material, preparing for examinations, and improving reading ability. Attention to the orientation of students in their attitudes and motivation, and the relation of these to satisfactory performance" (19, p. 74).

Two textbooks were used in the course (1, 17). The topics covered by the texts and by the course include such things as problems of reading, concentration, study methods, use of time, note making, writing, and preparation for examinations.

The Instructors

Both instructors in the study were Ph.D. candidates, with majors in educational psychology and minors in psychology. Both were using the same population and the same experimental procedures with different variables for their doctoral dissertations.

Instructor A had taught Personal Orientation 1 for one quarter prior to the experiment. In addition, he had had two years of previous

teaching and counseling experience at the high-school level.

Instructor B had taught Personal Orientation 1 for five previous quarters. He also had previous teaching experience on the college level.

Both instructors had had an opportunity to try out the different teaching methods before the start of the present experiment. In fact, it was the trial and error and experience with these different teaching methods that lead the instructors to become curious about which method might be superior.

The Instructional Methods

Three different methods of instruction are utilized in the present investigation. These include the instructor-centered method, the student-centered method, and the eclectic method.

Instructor-Centered

The instructor-centered teaching approach follows the line of the traditional lecture method. The philosophy of this method is that the instructor is the authority and his task is to convey information to students so that they may learn and apply.

After all pretest measures had been administered and prior to the beginning of the actual instruction, a syllabus was handed to the students, containing, in addition to general course information, specific reading assignments. The exact number of pages to be read in each textbook prior to each class period was specified in this syllabus.

No attempt was made to encourage student comments or questions in the instructor-centered method. The instructor began each period by calling roll, and then he proceeded to lecture. When, on occasion, a student would raise his hand to ask a question, the instructor would answer it directly and specifically. The instructor did not ask for student opinion or for students to share their experiences on their study problems. When a student's question had been answered, the instructor would continue his lecture or other activity.

The instructor maintained a formal but not a rigid attitude. Humor was occasionally introduced when appropriate. The instructor remained standing at all times.

The students were told to expect unannounced quizzes over reading material. These quizzes were exchanged and scored by students in class. The instructor read the answers, explained why each answer was correct, and answered any remaining questions from students directly.

Students were told that their grade depended upon their test scores from a final examination, a midquarter examination, and the short quizzes.

In addition to lecturing, the instructor occasionally lead students in a period of practice on a certain study technique. All such practice exercises were done at the direction of the instructor at the time and in the manner prescribed by the instructor.

Student-Centered

The student-centered teaching method followed in a general manner the method set forth by Flanders (7). The philosophy underlying this method is that a group of students has within itself the ability to solve its own problems under proper leadership. Since the how-to-study course is organized more to solving problems than toward conveying content, Flanders' technique seems ideally suited for testing the student-centered method.

After the pretests had been administered, the students were handed a syllabus with a statement of course objectives, fundamental considerations, names of the textbooks, and a list of personnel services available at the University. No mention of assignments was made in the syllabus.

Each student was given a name card to place before him on the table, and the informality of the class was emphasized by having each student introduce himself to the class. The instructor lead the class in a discussion of the ways in which a group operates, how it succeeds, and what may cause it to fail. He emphasized that the class belonged to the students, and they were responsible for its operation.

The students were divided into groups of six or less to talk over their study problems and compile a list of problems they felt were most important for them. These problems were listed on the board and organized into topics. The instructor told the class what parts of the textbooks related to each problem they had suggested.

Each student was asked to indicate the topics on which he would be most interested in working. The class was divided into committees on the basis of these choices. The committees were structured by the instructor to a limited extent. They were asked to elect a chairman and a recorder and were held responsible for investigating their topic, reporting their findings to the class, and presenting some class activity in which the entire class would participate.

At this point, the instructor assumed the role of a resource person. He circulated among the committees, answering questions, helping to provide information, and making suggestions when called upon. However, he attempted, as far as possible, to reflect questions in order to place primary responsibility upon the students themselves.

When the planning was completed, each com-

mittee presented its report in turn. The reports were presented in such a manner as to encourage class discussion. During the reports the instructor was seated among the students, and would interject ideas and questions occasionally, much as the students felt free to do.

Activities and reports varied widely. They included such things as panel discussions, open class discussions, short lectures, role-playing, movies, quizzes, reading tests, impromptu themes, surveys, use of the opaque projector, and practice on study skills.

The students were told that their grade would depend upon a final examination, a midquarter examination, any quizzes devised by the committees, and upon the quality of their class participation.

Eclectic

The eclectic method did not confine itself to any one manner of presentation. A combination of many instructional techniques was used. These included many of the techniques used in the two methods previously described.

The class syllabus contained the same information as the student-centered syllabus, plus a listing of the main topics to be covered in the course. The readings relating to each topic were also given.

Name cards and introductions were used to help the group get acquainted and establish a relatively informal atmosphere. A variety of instructional techniques was used with this group. The essential difference between the eclectic and student-centered methods was that in the former the instructor suggested the topics to be covered and the manner in which they were to be presented. The eclectic method differed from the instructor-centered method in that a maximum of student participation was encouraged, although occasional lectures were interspersed with other activities.

The primary technique used was class discussion. Different devices were used to get a maximum of group participation. The buzz session was a technique whereby students would be given a question posed by the instructor and would be asked to discuss it with fellow students sitting near them. This served to warm the students to a general class discussion. The six-by-six technique was a more formal type of buzz session. Groups of six or less students would be formed to discuss a question for six minutes and then report their conclusions back to the class.

The students were told that their grades would depend upon a final examination, a midquarter examination, unannounced quizzes, and the quality of their class participation.

Consistency of Instruction

One of the essential features in the design of this experiment is the principle of replication. To implement this principle it is important that the three treatment methods be consistently carried out as they are intended to be. Three techniques were used to check on the characteristics and consistency of the instruction: coordinated planning by the instructors, a survey administered to the students, and ratings of class recordings.

Coordinated Planning

The two instructors planned in detail the specific content to be covered and the specific instructional techniques to be used in both the instructor-centered and eclectic methods. This was also done for the first part of the student-centered method, when a certain amount of class structuring was necessary.

The coordinated planning was concerned not only with long-range goals but also with the specific daily plans. Before each day's teaching, the instructors prepared their activities jointly. In addition, instructor B, who taught the afternoon sections, routinely checked with instructor A at noon to ascertain whether the instruction had proceeded as planned. When for one reason or another the material covered was not exactly as planned, or instructor A had found it necessary to use some other technique, Instructor B altered his plans so as to conform as nearly as possible to what had occurred in the morning.

After the initial structuring in the student-centered groups, little instructor planning could occur. The groups had been taken over by the students and further instructor planning was not only unnecessary but unwise. However, the instructors did compare notes on the role they assumed in class to keep it as consistently student-centered as possible.

Survey of Opinions—Behavior (SOO-B)

The SOO-B was devised by the instructors to discover whether students perceived the instruction in the way it was intended. Eight items were derived from the definitions of the teaching methods. These are items 11–18 in the Survey of Opinions, a copy of which is found in the Appendix. The first ten items make up SOO-A, which is discussed in Part IV.

Arbitrary weights were assigned to each of the five possible responses of each item. A

weight of four was assigned to a response judged most representative of the instructor-centered method, and a weight of zero to a response most characteristic of the student-centered method. Intermediate weights of three, two, and one were assigned to corresponding intermediate responses. Thus, with these arbitrary weights, the highest possible score, indicating perception of an instructor-centered method, would be thirty-two; the lowest possible score, indicating perception of a student-centered method, would be zero.

The SOO-B was first administered at the end of the third week of instruction to the 166 random and nonrandom students present that day. Using these responses, a new series of weights was devised using the reciprocal averages technique (15). In brief, the method involves a series of successive approximations or iterations to obtain the item weights yielding a maximum internal consistency. Five iterations were necessary to stabilize the item weights for the SOO-B. The reliability of the final iteration was .87.

The SOO-B was administered first at the end of the third week, for the second time at the end of the sixth week, and for the third time during the final week of the quarter. For the first and second administrations all students present, whether random or nonrandom, were included in the analysis. An approximate method of calculating analysis of variance with unequal frequencies in cells was judged to be sufficient for analyzing this data (12, p. 261–266). For the third administration, only randomly placed students were used in the analysis and an exact test of significance was used (4). Only the analysis of the third administration is presented here. The analyses of the first and second administrations yielded approximately the same results. The hypotheses tested in all three administrations of the SOO-B are as follows:

1. No differences exist between mean scores of the SOO-B attributable to different time-instructors.

TABLE 8

MEAN SCORES OF SOO-B FOR EACH SECTION
THIRD ADMINISTRATION
$N = 111$ Random Students

Instructor	Method			Total
	Student-Centered	Eclectic	Instructor-Centered	
A	7.0952	10.8947	22.9000	13.5667
B	8.4667	9.5263	22.8235	13.6471
Total	7.6667	10.2105	22.8649	13.6036

2. No differences exist among mean scores of the SOO-B attributable to different teaching methods.

3. No interaction effect exists between teaching method and time-instructor.

For the third administration of the SOO-B the students were asked to base their responses on the entire quarter's work. One random student in section 5 missed this administration so the total number of students included is 111. The mean scores are reported in Table 8.

A high score indicates perception of an instructor-centered approach, and a low score indicates perception of a student-centered approach. Inspection of Table 10 reveals that the mean scores are highest for the instructor-centered sections, lowest for the student-centered sections, and intermediate for the eclectic sections. This would tend to indicate that on the average students perceived each class as the instructor intended to teach it. Furthermore, the two instructors were perceived to be operating similarly in each teaching method.

To test the significance of these differences, an exact method of analysis of variance was calculated. The analysis appears in Table 9. This analysis shows that the differences among methods are significant at far less than the one per cent level, while differences between time-instructors and the interaction are nonsignificant. The three administrations of SOO-B all

TABLE 9

ANALYSIS OF VARIANCE
SOO-B THIRD ADMINISTRATION
$N = 111$ Random Students

Source of Variation	*df*	Sum of Squares	Mean Square	*F*	Hypothesis Tested
Between Time-Instructors	1	.1057	.1057	<1	Accept
Among Methods	2	4879.8460	2439.9230	164.97*	Reject
Interaction	2	34.1947	17.0973	1.15	Accept
Error	105	1548.3398	14.7461		
Residual	107	1582.5345	14.7900		
Total	110				

* $p < .01$.

yielded the same general results. The students perceived each method as the instructors intended to teach it. Furthermore, the results indicate that the instructors were successful in coordinating their planning so that they consistently portrayed the definition of their roles during the entire quarter.

Class Ratings

As a further check on the consistency of instruction, tape recordings were made of all six sections during one day of instruction. The recordings were analyzed in several different ways. First, ratings were made of the amount of time that the instructor talked in each section. Second, two experienced teachers were asked to listen to each tape and identify which method of instruction was used. And finally, these two raters were asked to write a subjective description of each class after listening to the recordings.

Talk ratio. The tapes for all classes were played while raters tabulated at ten-second intervals whether a student or an instructor was talking. The tabulation was done by alternate ten-second intervals; that is, the first rater tallied at the end of 10, 20, 30, . . . seconds, while the second instructor tallied at the end of 5, 15, 25, . . . seconds. The percentage of total time occupied by the talking of the instructor is indicated in Table 10.

An inspection of this table shows that the highest percentage of instructor talk occurred in the instructor-centered sections and the lowest percentage in the student-centered. In the eclectic sections, both instructors talked about half the time. These results are in agreement with the general principles involved with each type of teaching. Of course it must be remembered that these percentages are based on only one day's instruction and not a necessarily typical day in the judgment of the instructors. They do give a rough idea as to the differences in communication patterns among the three methods.

Identification of methods. The recordings were presented to two other experienced teachers in order that they might identify the method used. These two raters were asked to match each tape recording with one of the three methods. They were given the definitions of the three methods, and then listened to the complete tape recording.

TABLE 10

PERCENTAGE OF TOTAL TIME OCCUPIED BY TALKING OF INSTRUCTOR ON ONE DAY

Instructor	Rater	Method		
		Student-Centered	Eclectic	Instructor-Centered
A	1	6.8	54.5	99.5
	2	4.5	57.6	99.5
B	1	15.3	52.0	84.6
	2	24.0	53.8	90.3

At the end of each recording each rater indicated on paper the method he thought had been utilized. Both raters were correct in the identification of all six class periods.

Subjective description. In addition to making an identification of each class, each of the two raters was also asked to write a brief paragraph of description. The descriptions for each class period for each rater are not included here, but the reader may find them in two sources (6, pp. 65–68; 13, pp. 65–68).

Subjective Impressions

Certain unscientific subjective impressions were formed by the instructors during the course of the experiment. Perhaps these impressions could best be expressed as answers to questions that have frequently arisen.

1. *Can one really change his teaching methods as quickly as was necessary to perform this experiment?* Changing one's method of instruction is not as difficult as it may seem. It involves some extra preparation but it can be done. In fact, one of the major subjective outcomes for the instructors was that they discovered they could be more flexible than they had previously thought possible.

2. *How did the students react to the idea of being guinea pigs for the experiment?* Actually, few if any students knew that an experiment on teaching methods was in progress. They were told that the tests they took were part of an evaluation study. This fact was made clear the first day the class met. However, they did not seem to be aware that their section was receiving a different type of instruction than any other How-to-Study section. Apparently, students discussed the activities of the class very little. Only one student mentioned the fact that his syllabus was not like that of another student's from a different class.

3. *Does one have trouble getting students to cooperate in taking the tests?* All testing took place during the class time. The students were promised a copy of their test results at the end of their testing. These were mailed to students who were interested enough to leave a self-addressed, stamped envelope. The students were most cooperative throughout the experiment.

4. *What sort of feelings does one have about each of the methods?* Certainly the instructor-centered method is the most "ego inflating" method from the point of view of the instructor. The students seem to have more "respect" for the instructor. They tend to address him as "Mr." or "Sir," and frequently stop after class to ask the instructor's opinion on a certain study problem. At the end of the quarter there seemed to be more expressions of gratitude from students in the instructor-centered method. In the eclectic and student-centered methods there was less of this particular brand of "respect." Students felt free to disagree with the instructor and less often stopped after class to ask questions. There is no question in the instructors' minds that they actually taught by three different methods.

IV. Evaluation Instruments

The purpose of this part is to describe each of the tests and criterion measures used in the present study. These include the final examination; the *Survey of Study Habits and Attitudes;* the *n* Achievement test; the Opinion, Attitude, and Interest Survey; the Survey of Opinions—Attitudes; the Preferred Instructor Characteristics Scale; the American Council on Education Psychological Examination; and the Personal Data card. The first four of these measures were administered to all students the first week of class before any instruction had been completed. The *first* administration is hereinafter referred to as the *pretest,* while the *second* administration is called the *posttest.*

Final Examination

A 99-item objective final examination was constructed to measure the students' knowledge and understanding of study problems. The process of standardization of the final examination was extended over four quarters of How-to-Study courses offered during 1953–1954 and 1954–1955. During the first three quarters the examination was constantly revised to eliminate the nondiscriminating items. The fourth and final form was administered to a group of 180 students from the fall, 1954, How-to-Study course. Their responses were analyzed in regard to item difficulty, item discrimination, and reliability.

The difficulty of the items was determined by the number of correct responses for each item. There were 46 items in the 25 to 75 per cent difficulty level, 50 above the 75 per cent level, and three below the 25 per cent level. The test was negatively skewed with regard to difficulty, with at least half of the items answered correctly by 75 per cent of the students.

Phi coefficients were calculated by using the upper and lower 27 per cent of the total distribution of scores. Sixty-seven, or two-thirds, of the 99 items correlated .20 or above with the total score. The remaining items fell in the chance area. None were reversal items. By means of Hoyt's (11) analysis of variance technique, the reliability coefficient was found to be .67. This is not as high as is desired for a criterion instrument. The relatively low reliability might have been a function of the restricted range of correct response due to lack of difficulty in the test. However, the reliability was judged sufficiently high to provide a reasonably accurate differentiation between individuals inasmuch as the *F* value "between individuals" in this analysis was significant at the one per cent level. A random sample of fifty students from the current experiment was used to provide a check on the reliability and an almost identical .68 was obtained.

Survey of Study Habits and Attitudes (SSHA)

The *Survey of Study Habits and Attitudes* (SSHA) was used to measure student changes in study habits and attitudes toward study. Brown and Holtzman (3) have reported most of the essential information about this measure in their manual. The SSHA is empirically keyed for those items which discriminated between students of high and low grade-point average. Because a sex difference was found in the predictive power of the items, the final form was scored on 36 items for men and 29 items for women. In the present investigation, the analysis of results for the SSHA is restricted to males because of the limited number of females.

The internal consistency reliability of the SSHA was estimated by Brown and Holtzman by the split-third method. For men, the Spearman-Brown prophecy formula estimated the reliability to be .92. The test-retest reliability after a two-week interval was .95. On other samples with an eleven-week interval between administrations the estimate was .88.

Estimates of the validity of the SSHA as a predictor of one-semester grade-point averages were obtained from samples of ten different universities across the country. The validity coefficients ranged from .27 to .66. All correlations were found to be positive and significantly different from zero for all schools.

The correlation between SSHA and ACE was found to be consistently lower than the correlations between either of these measures with grades. An exact test of the contribution of the SSHA to the prediction of grade-point average over and above that made by the ACE would utilize the multiple-regression technique. However, this was not reported, so the interpretation that the SSHA contributes unique valid variance to the prediction must be made with caution.

The mean of the total male group of the present investigation was found to be 30.71, which would be equivalent to the 30th percentile on the published norms based on 2,114 men from twelve different colleges. These means are significantly different at the one per cent level. This difference might be expected because many students enroll in the How-to-Study courses because they have academic difficulty and poor study habits. A random sample of 50 students was drawn to determine the internal consistency of the survey for the present investigation. Hoyt's analysis of variance technique gave a reliability coefficient of .88 for this group.

n Achievement (n Ach)

The *n* Achievement test, as its name implies, is a projective device designed to measure one's need for achievement. A complete description of this instrument may be found in a book by McClelland, Atkinson, Clark, and Lowell entitled *The Achievement Motive* (14). In many respects it is very similar to the *Thematic Apperception Test* (TAT) developed by Murray (16), but it differs from it in three major ways. First, although some of the TAT pictures may be used as stimuli, additional pictures have been specially prepared for the *n* Ach. Second, group testing is used. The pictures are flashed on a screen and the subjects write their stories. Third, the scoring system, though derived from some of Murray's concepts, is completely different from that used on the TAT.

The primary assumption in this test is that a person with a need to achieve, a person who might be termed ambitious, driving, or highly motivated, will project this need in the stories he devises. The stories, then, can be objectively scored by counting the number of achievement-related cues. The more highly motivated a person is, the more achievement cues he is expected to project.

Pictures A, B, D, and E (14, p. 375) were administered in that order. One psychologist scored all stories according to the detailed instructions (14, pp. 107–138). His scoring of 80 stories by 20 people correlated .81 with the scoring of these same stories by the authors (14, pp. 346–374). Furthermore, on another sample of 80 stories scored and rescored after an interval of a month, a score-rescore reliability of .91 was obtained by this psychologist.

A complete and detailed account of the validity of the *n* Ach is given in *The Achievement Motive* (14). No attempt is made here to reproduce this information. However, one study by McClelland (14) conducted on a sample of thirty Wesleyan College male veterans resulted in a correlation between *n* Ach and average grade of .51. When the results of a verbal and mathematical scholastic aptitude test were partialed out, the relationship between *n* Ach and grades was reduced to .39 (which is still significant at the five per cent level of significance). Thus the predictive validity of *n* Ach has been at least partially established by its ability to predict grades.

Opinion, Attitude, and Interest Survey (OAIS)

The OAIS was developed by Benno Fricke (8) to measure certain nonintellectual personality factors important in academic success. In other words, it attempts to measure motivation. This survey consists of 396 statements presented in a paired fashion—a total of 198 items.

The construction of the OAIS was based upon Science, Literature, and the Arts College male students at the University of Minnesota. Only students with ACE percentiles above 54 were included in the criterion groups used for item analysis. Fricke reports about 70 per cent of SLA students score above the 54 percentile on entering University of Minnesota norms (8, p. 164).

On the basis of ACE and honor-point ratio (HPR) Fricke selected a group of students designated as achievers and another group designated as nonachievers. He then performed an item analysis to discover which items of the OAIS (scored configurally) differentiated between these groups. The next step was to establish the usefulness of these items on a cross-validation sample of incoming students. He combined high school rank (HSR), *Ohio State Psychological Examination*, and the OAIS in a regression equation which revealed that the beta weight of the OAIS was significant at the one per cent level of confidence.

The zero order correlation coefficient (r) between the OAIS scores and HPR for the total cross-validation sample of 209 students was .40; the r for the 138 students having ACE percentiles greater then 54 was .46; and the r for the 71 students having ACE percentiles below 55 was .28.

Three limitations should be kept in mind regarding the use of the OAIS in this study:

1. The OAIS was validated on students with

above-average academic ability. The mean ACE (1947 form) raw score was 119, equivalent to the 72nd percentile on norms based on entering freshmen in Minnesota colleges. Students in the present investigation, on the average, scored lower. Their mean ACE (1952 form) raw score was 100, equivalent to the 39th percentile on equivalent norms.

2. The scoring keys were derived from an item analysis of male responses only.

3. The original purpose of the OAIS was to discover personality variables predictive of academic success prior to entrance to college. In the present study this instrument is being applied to students already enrolled in college. Furthermore, these students have undergone a selection process in becoming members of the present study.

Thus both the situation and the nature of the population have been altered in the present application of this instrument.

Survey of Opinions—Attitudes (SOO-A)

The purpose of the SOO-A is to provide a quantitative measure of student attitudes toward class on a favorable-unfavorable continuum. It consists of items 1–10 on the Survey of Opinions, a copy of which will be found in the Appendix. Each of these ten statements has five possible responses. The directions instruct the students to answer each question on a percentage basis. That is, he is asked to estimate what percentage of the time he feels a certain way toward the class.

This measure was devised by the instructors in this study simply on the basis of the face validity of each item. Arbitrary weights were assigned to each response to each question. A weight of four was first assigned to the response believed to be most favorable toward the class, three to the next most favorable, on down to zero for the least favorable response to each item. Thus a student with the most favorable attitude toward the class could possibly get a maximum score of forty, and a student with the most unfavorable attitude toward the class could possibly obtain a minimum score of zero.

This questionnaire was administered three times during the quarter to the students in the How-to-Study classes. On the basis of the responses of 145 students taking the second administration, a new series of weights was assigned to the responses using the method of reciprocal averages (15). The weights stabilized after three iterations with few changes in weights and with a reliability of .89. The third administration of the SOO-A is referred to as the SOO-A-3 and was given at the end of the quarter with instructions to consider the entire quarter's work in answering the questions.

The Preferred Instructor Characteristics Scale (PICS)

The primary purpose of this investigation is to discover the effect of different teaching methods on various student outcomes. However, one of the important subsidiary problems is concerned with the effect of students' prejudice for or against a certain kind of teaching method on their outcomes under each condition. There was a need for some instrument to measure this prejudice, and the PICS was designed to meet this need. It is similar in design and theory to an instrument developed by N. L. Gage and others (9, pp. 17–19).

A "cognitive-affective" continuum of instructor characteristics was postulated. A cognitive instructor was defined as one concerned with the intellectual, abstract, subject-matter goals of teaching; the affective instructor was defined as being more concerned with emotional adjustments and student interactions in the classroom. The cognitive instructor corresponds to the instructor-centered instructor of the present investigation, while the affective instructor corresponds to the student-centered type of instructor.

The instructors in this study proposed a number of statements that they believed characterized each of the two type of instructors. Then, to obtain some degree of face validity, they submitted the statements to three advanced graduate students in educational psychology and one instructor in humanities with directions to separate the items according to whether they were "affective" or "cognitive" as defined above.

Only statements which were unanimously classified by all four judges, plus the two instructors, were retained for the scale. Eight cognitive and eight affective items met this criterion.

Each cognitive statement was paired with each affective statement to form a 64-item paired-comparison forced-choice instrument. This form was administered to two fall, 1954, How-to-Study sections to provide the basis for an item analysis. The item analysis revealed that two statements of each type were not discriminating because they were either almost always chosen or almost never chosen. These four statements were discarded. The remaining six cognitive and six affective items were again paired to form a 36-item paired-comparison forced-choice instrument. The order of each type of statement within each item was randomly determined. The resulting form appears in the Appendix.

The PICS is scored in such a way that a high score indicates that the student prefers a cognitive-type approach, while a low score indicates preference for an affective approach. The

maximum score is 36, while the minimum score is zero.

The reliability of the PICS was measured in several ways. It was administered to two different sections of the fall, 1954, How-to-Study class and item analyzed again. Thirty-four of the 36 items yielded a phi coefficient of .20 or higher, indicating that the vast majority of items were successfully discriminating between the upper and lower 27 per cent of the distribution.

A measure of the test-retest reliability was obtained by administering the PICS to 21 night-school students on two occasions with a four-week intervening period. A test-retest reliability coefficient of .88 was obtained.

One further check on the internal consistency of the PICS was made by obtaining a random sample of fifty students from the present investigation. Using Hoyt's analysis of variance technique (11) a reliability coefficient of .90 was obtained. The PICS was administered on the first day of class to students involved in the present study.

American Council on Education Psychological Examination (ACE)

The ACE is widely known and used as a test of scholastic aptitude. Because of this fact a discussion of its construction, administration, scoring, reliability, and validity is unnecessary.

The ACE scores for students in the present investigation were obtained from the files in the Student Counseling Bureau at the University of Minnesota. If a student had not taken the 1952 form of the ACE, his score on one of the other forms was transformed to the 1952 raw score equivalent by means of conversion tables provided by the Student Counseling Bureau. Of the 111 randomly assigned students for whom ACE scores could be located, 58 had taken the 1952 form, 42 had taken the 1947 form, and 11 had taken the 1937 form.

Personal Data Card

A personal data card was employed to collect information about each student's college, class, home and local address, telephone number, age, and sex. In addition, the card was used to record all the test data collected for each student.

Intercorrelation of Instruments

Table 11 presents the intercorrelations of the evaluation instruments based on 80 randomly assigned males on whom complete data were available.

It should be noted that all measures which were administered twice had a test-retest reliability significantly different from zero at the .01 level, yet each of these reliabilities was far from perfect. The two tests which purport to measure motivation (OAIS and *n* Ach) correlate consistently positively with each other, but only on the pretests does this reach significance at the .05 level. Only the final examination shows any significant relationship with the ACE. The two measures of achievement (SSHA and final examination) correlate significantly but not highly with each other.

It should also be noted that the OAIS correlates significantly with all measures of achievement, while *n* Ach reaches significance at the .05 level with only one—the final examination posttest. Liking for class (SOO-A-3) seems to have little relationship with any of the other measures. The PICS is found to correlate significantly with the OAIS on both the pre- and posttest administrations. It also shows a surprisingly high relationship with the SSHA posttest. Perhaps this is an indication that the PICS may have possibilities as a measure of motivation.

V. Results

The primary hypotheses as outlined in

TABLE 11

INTERCORRELATIONS OF THE EVALUATION INSTRUMENTS

($N = 80$)

Variables	ACE	SSHA (Pre)	SSHA (Post)	Final (Pre)	Final (Post)	PICS	*n* Ach (Pre)	*n* Ach (Post)	OAIS (Pre)	OAIS (Post)	SOO-A-3
ACE		.18	−.01	.32†	.27*	−.07	.17	.12	−.02	−.09	−.14
SSHA (Pre)			.69†	.35†	.32†	.13	−.06	.02	.26*	.26*	.07
SSHA (Post)				.32†	.27*	.47†	−.05	.13	.23*	.34†	.26*
Final (Pre)					.59†	.19	.15	.10	.31†	.33†	.20
Final (Post)						.16	.22*	−.03	.25*	.27*	−.11
PICS							.00	.06	.30†	.25*	.06
n Ach (Pre)								.49†	.26*	.20	.00
n Ach (Post)									.18	.17	.04
OAIS (Pre)										.60	−.03
OAIS (Post)											.20
SOO-A-3											

* Significantly different from zero at the .05 level.
† Significantly different from zero at the .01 level.

Part II are tested first. Following this the subsidiary hypotheses are tested. As specified in Part II, two assumptions for the use of analysis of variance and covariance are tested in these analyses. The variance within each cell is assumed to be homogeneous, and for all covariance problems the linear regression coefficients within each cell are assumed to be homogeneous. In the text of this part, no further mention is made of these assumptions unless they appear to be violated in a particular analysis. Each analysis in the tables of results is marked if either assumption is violated.

For each problem in the investigation an analysis of variance has been calculated on the pretest scores and on the posttest scores. In addition a covariance analysis has been calculated on the posttest scores adjusted for pretest scores. The analysis of most concern is the covariance analysis because any differences in posttest scores are adjusted for differences that might have existed in the initial scores.

Tests of Primary Hypotheses

The primary null hypotheses of the present investigation may be stated as follows:

1. No differences exist among mean scores of the criterion instruments attributable to different methods of teaching.
2. No differences exist between mean scores of the criterion instruments attributable to different time-instructors.
3. No interaction effect exists between teaching method and time-instructor.

The three null hypotheses are tested for each of the four criterion instruments plus the SOO-A-3. For each instrument a separate analysis is made for males and females combined and for males alone. No analysis of females alone is made because of the extremely small frequencies within each cell. On the SSHA no analysis of males and females combined is made because of the different scoring keys for each sex.

Each analysis of variance (AV) and each analysis of covariance (AC) is summarized in one row of Table 12. The table indicates whether the analysis was performed on pretest scores (pre) or posttest scores (post), and whether males and females combined (MF) or males only (M) were analyzed.

Table 12 reveals that the primary null hypotheses on posttest scores are all accepted on the final examination, the SSHA, and OAIS. However, the analysis of covariance of *n* Ach posttest scores for males and females combined reveals that the hypothesis of no method difference has been rejected at the .05 level.

What is the nature of the differences between methods? Which method produced the highest level of motivation and which the lowest? The mean scores for each method are presented in Table 13.

The adjusted mean score in Table 13 is the posttest mean score adjusted for the pretest mean score by means of the regression coefficient. It is the difference in adjusted mean scores that is of importance. The students taught by the eclectic method scored highest. The students from the instructor-centered sections were next highest, and the students in the student-centered sections scored lowest. The chances are less than one in twenty that differences as great as these could have arisen by chance alone.

However, what is the significance of the difference of each method compared with each other? Scheffé (18) has suggested a technique for judging contrasts in analysis of variance. In judging contrasts in analysis of covariance the procedure is virtually identical except that adjusted mean scores are contrasted and the estimated variance of the difference

TABLE 12

SUMMARY OF *F* VALUES TESTING PRIMARY HYPOTHESES

Variable	Total *df*	Pretest or Posttest	Analysis of Variance or Covariance	M or MF	*F* Values for each Source of Variation		
					Among Methods	Between Time-Instructors	Interaction
Final Examination	111	Pre	AV	MF	<1	<1	2.77
	111	Post	AV	MF	1.02	<1	1.82
	110	Post	AC	MF	<1	1.55	<1
	82	Pre	AV	M	1.24	2.22	2.15
	82	Post	AV	M	<1	<1	3.05
	81	Post	AC	M	<1	<1	1.53
SSHA	82	Pre	AV	M	2.75	<1	1.25
	82	Post	AV	M	1.58	1.71	<1
	81	Post	AC	M	<1	1.55	<1
n Ach	109	Pre	AV	MF	<1	2.26	<1
	109	Post	AV	MF	3.72[c]	<1	<1
	108	Post	AC	MF	3.41[c]	<1	<1
	80	Pre	AV	M	1.45	<1	<1
	80	Post	AV	M	1.54	<1	<1
	79	Post	AC	M	<1	<1	<1
OAIS	109	Pre	AV	MF	2.60	<1	<1
	109	Post	AV[a]	MF	1.55	<1	<1
	108	Post	AC[b]	MF	<1	<1	<1
	80	Pre	AV	M	5.06[d]	<1	1.56
	80	Post	AV[a]	M	1.61	<1	<1
	79	Post	AC[b]	M	<1	<1	<1
SOO-A-3	109	Post	AV	MF	3.69[c]	<1	6.03[d]
	80	Post	AV	M	<1	<1	2.86

[a] Assumption of homogeneous variances violated.
[b] Assumption of homogeneous regression coefficients violated.
[c] Significant at the .05 level.
[d] Significant at the .01 level.

between adjusted means is slightly increased (5, p. 79).

A null hypothesis of no difference in mean *n* Ach scores for each pair of methods is tested. Scheffé's technique reveals that only the contrast between the eclectic and student-centered methods is significant at the five per cent level. The other contrasts do not reach significance.

Thus we may conclude, with less than one chance in twenty of being wrong, that for this population the eclectic teaching method motivates students to a higher level than does the student-centered teaching method. The instructor-centered teaching method tends to be intermediate between the other two meth-

TABLE 13

n ACH MEAN SCORES[a] ASSOCIATED WITH EACH METHOD

(Males and Females)

Test	Method		
	Instructor-Centered ($N=37$)	Eclectic ($N=36$)	Student-Centered ($N=36$)
Pretest	15.00	15.54	14.64
Posttest	16.30	17.73	15.03
Adjusted Score	16.32	17.56	15.18

[a] These scores include a constant of 10 added to each score to eliminate negative numbers.

ods, but contrasts involving the instructor-centered method do not reach significance.

It is interesting to note that all three null hypotheses are accepted when *males only* are analyzed on the *n* Ach. Apparently, then, the majority of the contribution toward method differences is accounted for by the females.

The present results tend to raise more questions than they answer. In previous research (14) the different motivating conditions were established by means of relatively brief directions. Males were affected by differences in these brief motivating conditions in the expected direction, but females were not. Females seemed to respond in the same manner whether they were motivated under a relaxed condition or under an achievement-oriented condition. The present investigation, by extending the stimulating conditions over a ten-week period of time, may have been long enough to differentially motivate the females. In addition, the social climate may have been sufficiently different under each method to cause different perceptions and reactions. Other explanations are possible. Further research is necessary to isolate the exact nature and etiology of the sex differences associated with *n* Ach.

A significant interaction is evident for the analysis of variance of the SOO-A-3. This interaction precludes any test of the main effects because of the assumption of no interaction in the model used with unequal frequencies in cells (4).

The SOO-A measures attitudes toward class on a favorable-unfavorable continuum. The third administration of the SOO-A is analyzed because it was conducted at the end of all instruction when students were asked to view the entire quarter's work in answering the questionnaire.

TABLE 14
MEAN SOO-A-3 SCORES
(Males and Females)

Time-Instructor	Method			Total
	Instructor-Centered	Eclectic	Student-Centered	
A	28.1	25.8	29.8	28.0
B	32.8	27.5	25.1	28.6
Total	30.3	26.7	27.9	28.3

The reason for the significant interaction can be seen in Table 14. A higher score tends to indicate a more favorable attitude toward class. The interaction is due to the fact that the instructor-centered section of time-instructor B scored higher than the corresponding section of time-instructor A, but the student-centered section of time-instructor A scored higher than the corresponding section of time-instructor B. The differences are not as wide in the eclectic sections. It appears that each instructor (or possibly the time of day) had a method with which he could best please the students, but the same method did not please each group of students equally well for each instructor.

Tests of Subsidiary Hypotheses on Preference Levels

One of the subsidiary problems of this investigation involved the possibility that a preconceived bias concerning the teaching methods might influence the outcomes associated with each method. The PICS, described in Part IV, was designed to measure this bias. On the basis of PICS scores the random students were classified into three categories of approximately equal size. The high scoring third are those students who tend to prefer a more directive or instructor-centered approach; the low scoring third would tend to prefer the student-centered method; while those in the middle might be likely to

prefer some combination of both, presumably the eclectic method.

The exact design for this analysis is set out in Part II. In brief, the purpose of this analysis is to see if differences on the criterion instruments appear to be related to preferences for the different methods as measured by the PICS. At the same time it is possible to discover any interaction effect between preference for instruction and the actual instruction given. A covariance analysis adjusting posttest scores for pretest scores has been carried out to test the following null hypotheses:

1. No differences exist among mean scores of the criterion instruments attributable to different teaching methods.
2. No differences exist among mean scores of the criterion instruments attributable to different PICS levels.
3. No interaction effect exists between method and PICS level.

The first hypothesis is identical to the first of the primary hypotheses, and consequently the results in the following analysis are identical. It is necessary to include this hypothesis again in order to isolate the variation due to method differences and provide a means for measuring the interaction effect between actual teaching methods and preference for method. The results are summarized in Table 15, which utilizes the same symbols as Table 12.

A highly significant F value can be noted for the covariance analysis of SSHA scores. Apparently then, study

TABLE 15

SUMMARY F VALUES TESTING SUBSIDIARY HYPOTHESES ON PREFERENCE LEVELS

Variable	Total *df*	Pretest or Posttest	Analysis of Variance or Covariance	M or MF	F Values for Each Source of Variation		
					Among Methods	Among PICS Levels	Interaction
Final Examination	111	Pre	AV	MF	<1	1.19	<1
	111	Post	AV	MF	<1	<1	1.76
	110	Post	AC	MF	<1	<1	1.75
	81	Pre	AV	M	<1	1.41	1.58
	81	Post	AV	M	<1	1.82	<1
	80	Post	AC	M	<1	<1	<1
SSHA	82	Pre	AV	M	2.29	<1	<1
	82	Post	AV	M	<1	5.58[c]	<1
	81	Post	AC	M	<1	7.39[c]	<1
n Ach	109	Pre	AV	MF	<1	<1	<1
	109	Post	AV	MF	3.86[b]	<1	1.44
	108	Post	AC	MF	3.41[b]	<1	1.70
	80	Pre	AV	M	1.80	<1	<1
	80	Post	AV	M	1.49	<1	1.10
	79	Post	AC	M	<1	<1	1.63
OAIS	109	Pre	AV	MF	2.51	1.92	<1
	109	Post	AV	MF	1.43	2.48	<1
	108	Post	AC[a]	MF	<1	<1	<1
	80	Pre	AV	M	5.08[c]	2.59	<1
	80	Post	AV	M	1.38	3.72[b]	<1
	79	Post	AC[a]	M	<1	1.94	<1

[a] Assumption of homogeneous regression coefficients violated.
[b] Significant at the .05 level.
[c] Significant at the .01 level.

TABLE 16

MEAN SSHA PRE- AND POSTTEST SCORES FOR THE HIGH, MEDIUM, LOW PICS GROUPS (Males)

Administration	PICS Levels		
	Low	Medium	High
Pretest SSHA	29.76	29.82	33.08
Posttest SSHA	25.97	29.21	37.38

habit changes do show some relationship to the students' original preferences for a certain type of instruction; and since the interaction is not significant, it can be concluded that this is true regardless of the type of method they actually receive. The nature of this relationship can be seen in Table 16.

Since the differences among methods and the interaction are not significant, the scores from all methods have been pooled to form the mean scores of Table 16. The trend was for the low PICS group to decrease their SSHA scores, for the medium group to rate themselves about the same, and for the high group to increase their SSHA scores over the period of instruction. It appears that the male students who originally preferred a more cognitive or directive teaching method showed the most improvement in their self-ratings on study habits. Those who originally preferred a more affective or student-centered approach tended to rate their own study habits lower after instruction than they did before no matter what type of instruction they actually received.

The reasons for this result are not apparent. However, one hypothesis may be that the PICS discriminates the student who wants to get something out of the how-to-study course from the student who just wants to pick up two credits. On the other hand, since the PICS and the SSHA are positively correlated with each other, this result may simply be an artifact of this relationship, and both tests are simply measures of a positive academic attitude—an attitude that characterizes students who are academically successful. However, this does not explain why the PICS and the posttest SSHA correlate .47 while the PICS and the pretest SSHA correlate only .12. It is conceivable that the PICS is a measure of motivation toward academic success, but further research is needed to substantiate this hypothesis.

The analysis of variance of OAIS posttest scores for males only does reach significance at the .05 level. The covariance analysis (adjusting for initial pretest differences) is questionable because the assumption of homogeneous regression coefficients has been violated. However, it seems questionable to accept the conclusions of the analysis of variance of unadjusted posttest scores. Differences among PICS levels also appear in the pretest scores, although not quite reaching significance ($F = 2.59$). An exact test is not possible, but it appears that differences among PICS levels on posttest scores are largely the result of initial differences. Furthermore, the initial differences are possibly due to the correlation of the PICS and the OAIS as noted in Part IV.

Tests of Subsidiary Hypotheses on Ability Levels

The second subsidiary problem concerns the scholastic ability level of students and its effect on outcomes under each teaching method. The possibility that bright students might have different outcomes than those less bright, and the possibility that there might be some interaction between ability level and the actual teaching method used are to be tested here. The specific hypotheses to be tested may be stated as follows:

1. No differences exist among mean scores of the criterion instruments attributable to different teaching methods.
2. No differences exist among mean scores of the criterion instruments attributable to different ability levels.
3. No interaction effect exists between teaching method and ability level.

Here again the first hypothesis repeats the first of the primary hypotheses in order to isolate method differences and to provide for the test of interactions. The results are summarized in Table 17.

Examination of Table 17 reveals no significant F values for posttest scores that have not already been mentioned.

TABLE 17

SUMMARY OF *F* VALUES TESTING SUBSIDIARY HYPOTHESES ON ABILITY LEVELS

Variable	Total *df*	Pretest or Posttest	Analysis of Variance or Covariance	M or MF	*F* Values for Each Source of Variation		
					Among Methods	Among ACE Levels	Interaction
Final Examination	111	Pre	AV	MF	<1	1.53	<1
	111	Post	AV	MF	1.05	2.73	<1
	110	Post	AC	MF	<1	2.11	<1
	81	Pre	AV	M	1.37	3.40[b]	<1
	81	Post	AV	M	<1	2.30	<1
	80	Post	AC	M	<1	<1	1.05
SSHA	81	Pre	AV	M	2.59	<1	<1
	81	Post	AV	M	1.13	<1	<1
	80	Post	AC	M	<1	1.17	<1
n Ach	108	Pre	AV	MF	<1	2.39	<1
	108	Post	AV	MF	4.04[b]	<1	1.43
	107	Post	AC	MF	3.51[b]	<1	1.97
	79	Pre	AV	M	1.80	1.77	<1
	79	Post	AV	M	1.66	<1	<1
	78	Post	AC[a]	M	<1	<1	1.29
OAIS	108	Pre	AV	MF	2.53	<1	<1
	108	Post	AV	MF	1.45	1.32	1.35
	107	Post	AC	MF	<1	<1	1.02
	79	Pre	AV	M	4.88[b]	<1	<1
	79	Post	AV	M	1.60	<1	<1
	78	Post	AC	M	<1	<1	1.02

[a] Assumption of homogeneous variances violated.
[b] Significant at the .05 level.

Apparently, scholastic aptitude as measured by the ACE bears no significant relationship to outcomes on the variables used in this study. There does not appear to be any tendency for a bright student to be more successful under one teaching method than another.

VI. SUMMARY AND CONCLUSIONS

The primary problem in the present investigation is to discover any achievement or motivational differences that may result from three different methods of teaching in a how-to-study course. The population consists of all University of Minnesota students who elected to take Personal Orientation 1, How to Study, in the winter quarter of 1955. Approximately 63 per cent of the 192 students enrolled were randomly assigned to three teaching methods taught by two instructors at two different times of the day. Although nonrandom students do not appear to be essentially different from the random students on any of the characteristics examined, the analysis of results is confined to the random students.

The three teaching methods are termed instructor-centered, student-centered, and eclectic. The instructor-centered method emphasizes the intellectual content of the course and consists primarily of lectures and instructor-directed activity. The student-centered approach tends to emphasize the more affective aspects of the classroom and deals with student problems by means of committee work and student-led discussions. The

eclectic method consists of a combination of the previous emphases and proceeds primarily by means of instructor-led class discussion interspersed with a variety of other techniques. Checks on the consistency of instruction by each instructor in each method by means of coordinated planning, a student rating on instructor behavior, and judges' ratings of class recordings tended to affirm the consistency of instruction.

A design embodying the principles of replication, randomization, and control is utilized. Null hypotheses are constructed to test the relationship of method, time-instructor, and interaction to pretest and posttest measures of motivation and achievement. Subsidiary analyses of the effect of original preference for instructional method and ability-level on motivational and achievement outcomes associated with each method are conducted. Analysis of variance and covariance by least-squares analysis is the primary statistical tool.

Five criterion instruments are utilized. The final examination is a 99-item, objectively scored, test of knowledge about the course content. *The Survey of Study Habits and Attitudes* (SSHA) was used to obtain student self-ratings of study habits and attitudes. The *n* Achievement test (*n* Ach) is a projective technique designed to measure achievement motivation. The Opinion Attitude and Interest Survey (OAIS) is a configurally scored inventory which has been shown to contribute significantly to the prediction of honor-point ratio. All four of these instruments were administered both before and after the instructional period. The fifth instrument is the Survey of Opinions—Attitudes (SOO-A), a questionnaire designed to measure student attitudes toward class on a favorable-unfavorable continuum.

The results of this study may be stated as follows:

1. Significantly different motivational outcomes as measured by the *n* Ach are found among the three teaching methods for males and females. Students in the eclectic section were most highly motivated as measured by *n* Ach; the instructor-centered students were second; and the student-centered students showed the least increase. These method differences disappear when males only are analyzed, indicating the major contribution of females to these differences.

2. Differences in outcomes as measured by the final examination, the SSHA, and the OAIS are not significantly different for the three methods.

3. On the final administration of the SOO-A for males and females an interaction of method with time-instructor is found. The method which was most successful in pleasing the students under one instructor (or possibly at one time of day) was not most successful under another instructor (or at another time of day).

4. When students are categorized on the basis of their original preference for teaching method, it is found that students who originally expressed a preference for a more cognitive-type instruction increased their self-ratings of study habits and attitudes (SSHA). Students who originally preferred a more affective or student-centered type of instruction tended to lower their self-ratings. This was true regardless of the type of instruction they actually received. On the other variables no such differences were observed.

5. When students are categorized on the basis of their scholastic-ability level as measured by the ACE, no significant motivational or achievement outcomes are found in relation to ability level. Fur-

thermore, there is no tendency for bright students to have any different outcomes under one teaching method than another.

Previous research on teaching methods has dealt with extreme teaching methods. This may have been done to maximize the possibility of obtaining significant differences. The present investigation illustrates the importance of considering an intermediate *eclectic* method combining the advantages of both the typical lecture and the typical group approach. Many of the studies on teaching methods cited by Farquhar (6) could be profitably repeated with the introduction of an eclectic method. It could well be that a combination method is far superior to either extreme in implementing many educational objectives. Certainly the results of this study point in that direction.

In designing an investigation similar to the present one several improvements could be made. Many students were lost to the analysis because the randomization procedure was incomplete. If it were possible administratively to assign all students randomly, the precision of the experiment would be increased. Another administrative problem concerns the use of a no-treatment control group. No evidence can be obtained from the present design as to whether instruction by any method is more effective than no instruction at all. Where possible, future research designs of this nature could be improved by more complete randomization and the institution of a no-treatment control group. Complete details of this investigation, including reviews of literature and the raw data, may be found in two sources (6, 13).

Further research in other subject matter areas and with other populations is necessary to substantiate the results of this study. The study poses many questions which can only be answered by controlled experimentation.

Appendix

PREFERRED INSTRUCTOR CHARACTERISTICS SCALE

Directions:

What kind of an instructor do you prefer? In the following items you will find two instructor characteristics paired. From each pair choose the one characteristic you most prefer. Then mark your choice in the proper column on the special answer sheet. Do not omit any items. This is to find out your preferences. *There are no right or wrong answers.*

I prefer an instructor who:

1. *a.* is an expert.
   b. treats us as mature people.
2. *a.* makes the classroom pleasant.
   b. thinks logically.
3. *a.* understands our point of view.
   b. is well known in his field.
4. *a.* is dedicated to his students.
   b. is dedicated to his subject.
5. *a.* thinks logically.
   b. is friendly.
6. *a.* is well known in his field.
   b. makes the classroom pleasant.
7. *a.* is interested in us.
   b. covers all the material.
8. *a.* is dedicated to his students
   b. knows the theoretical background of his subject.
9. *a.* thinks logically.
   b. treats us as mature people.
10. *a.* is friendly.
    b. is well known in his field.
11. *a.* covers all the material.
    b. understands our point of view.
12. *a.* is interested in us.
    b. is dedicated to his subject.
13. *a.* is an expert.
    b. is dedicated to his students.
14. *a.* is well known in his field.
    b. treats us as mature people.
15. *a.* covers all the material.
    b. makes the classroom pleasant.
16. *a.* understands our point of view.
    b. is dedicated to his subject.
17. *a.* is interested in us.
    b. knows the theoretical background of his subject.
18. *a.* is friendly.
    b. covers all the material.
19. *a.* makes the classroom pleasant.
    b. is dedicated to his subject.
20. *a.* knows the theoretical background of his subject.
    b. understands our point of view.
21. *a.* is interested in us.
    b. is an expert.
22. *a.* is dedicated to his students.
    b. thinks logically.
23. *a.* treats us as mature people.
    b. covers all the material.
24. *a.* is dedicated to his subject.
    b. is friendly.

25. *a.* makes the classroom pleasant.
    b. knows the theoretical background of his subject.
26. *a.* is an expert.
    b. understands our point of view.
27. *a.* is dedicated to his students.
    b. is well known in his field.
28. *a.* is dedicated to his subject.
    b. treats us as mature people.
29. *a.* is friendly.
    b. knows the theoretical background of his subject.
30. *a.* is an expert.
    b. makes the classroom pleasant.
31. *a.* thinks logically.
    b. is interested in us.
32. *a.* treats us as mature people.
    b. knows the theoretical background of his subject.
33. *a.* is an expert.
    b. is friendly.
34. *a.* thinks logically.
    b. understands our point of view.
35. *a.* is interested in us.
    b. is well known in his field.
36. *a.* is dedicated to his students.
    b. covers all the material.

Check to see if you left any blanks.

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SURVEY OF OPINIONS

Directions:

The purpose of this survey is to determine your opinions about this course. Please be frank and honest in your answers. Naturally, this will not affect your grade in any way. It is important for the instructor to know how the class feels on each of these questions.

To help you in answering, the following terms have been defined on a percentage basis as follows:

A—Almost always—from 86 to 100 per cent of the time
G—Generally—from 66 to 85 per cent of the time
F—Frequently—from 36 to 65 per cent of the time
S—Sometimes—from 16 to 35 per cent of the time
R—Rarely—from 0 to 15 per cent of the time

Circle the letter corresponding to your own opinion:

A G F S R 1. I enjoy this class.
A G F S R 2. I feel this class has been valuable to me.
A G F S R 3. I feel "at home" in this class.
A G F S R 4. This class has been well taught.
A G F S R 5. I am glad I took this course.
A G F S R 6. I think class time is well spent.
A G F S R 7. I look forward to each class meeting.
A G F S R 8. This class is interesting to me.
A G F S R 9 I feel the instructor wants me to do well.
A G F S R 10. I feel this is an important class for me.
A G F S R 11. The instructor encourages us to answer our own questions.
A G F S R 12. The problems we work with arise out of the questions we suggest.
A G F S R 13. We have opportunities to compare our ideas and methods with others in the class.
A G F S R 14. We evaluate our own activities in class.
A G F S R 15. We work with the rest of the class to get answers to our questions.
A G F S R 16. The instructor lectures.
A G F S R 17. The instructor determines what topics will be discussed.
A G F S R 18. The assignments are very clear and definite.

SCORING KEYS

Preferred Instructor Characteristics Scale (PICS)

A plus one is given for each of the following cognitive responses:

1. *a*	7. *b*	13. *a*	19. *b*	25. *b*	31. *a*
2. *b*	8. *b*	14. *a*	20. *a*	26. *a*	32. *b*
3. *b*	9. *a*	15. *a*	21. *b*	27. *b*	33. *a*
4. *b*	10. *b*	16. *b*	22. *b*	28. *a*	34. *a*
5. *a*	11. *a*	17. *b*	23. *b*	29. *b*	35. *b*
6. *a*	12. *b*	18. *b*	24. *a*	30. *a*	36. *b*

Survey of Opinions

The following weights, derived from the final iteration, were used:

	SOO-A						SOO-B					
Item	Response					Item	Response					
	A	G	F	S	R		A	G	F	S	R
1.	4	3	1	0	0	11.	1	1	3	4	4
2.	4	3	2	1	1	12.	0	2	3	4	4
3.	4	2	3	1	0	13.	0	2	2	3	4
4.	4	3	2	0	0	14.	0	2	2	3	4
5.	4	3	2	1	0	15.	0	1	2	4	4
6.	4	3	2	1	0	16.	3	3	1	1	0
7.	4	4	2	1	1	17.	3	2	2	1	0
8.	4	3	2	1	0	18.	3	1	0	0	1
9.	3	3	2	2	0						
10.	4	3	2	1	0						

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